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VOLUME & YIELD of NORTHERN WHITE CEDAR IN THE LAKE STATES

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VOLUME AND YIELD OF NORTHERN WHITE CEDAR IN THE LAKE STATES

A Progress Report

By S. R. Gevorkiantz and William A. Duerr

1939

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VOLUME AND YIELD OF NORTHERN WHITE CEDAR

IN THE LAKE STATES

INTRODUCTION

Stands of northern white cedar (Thuja occidentalis L.) occupy about 1¼ million acres in the three Lake States (Michigan, Wisconsin, and Minnesota). In the northern part of the region -- cedar's commercial range -- cedar forests comprise 3½ percent of the forested area. The standing volume of merchantable cedar amounts to more than 1¼ billion cubic feet.

Cedar has held a unique position among commercial trees in the northern Lake States in being the chief source of such special products as poles, shingles, paving blocks, and posts. Despite a long history of cutting for these products and for ties and lumber, the cedar forests of the Lake States still supply annually some 500,000 poles, 9½ million posts, 500,000 ties, 120 million shingles, and 115,000 cords of other products. The long life of cedar stands and their ability to reproduce well on a variety of sites promise the continued importance of cedar in the forests of the region.

Northern white cedar is one of the few timber species of the Lake States for which sufficient volume and yield information has not been available. With the object of making up some of this deficiency of information on one of the commercially important trees of the region, the tables contained in this report have been compiled from the results of a number of studies made over a period of years by the Lake States Forest Experiment Station. The principal source of material has been the volume, utilization, and growth studies of the Lake States Forest Survey.

The following tables are not intended to cover completely the subject of cedar volume and yield. As regards volume tables, the wide variety of utilization standards observed in the cutting of cedar, and the many products and combinations of products obtained make it difficult to anticipate all possible needs for the various types of tables. Rather, it has been thought best to present only a few volume tables, but to include all the necessary basic tables from which others may be prepared according to individual need. Again, much remains to be learned concerning the yield of cedar stands. Yield studies available at present do not give adequate answers to such problems as the effects of site, of other species in mixture, or of the uneven-aged condition of stands. The tables presented are, however, a compilation of the best data yet available on the growth and yield of cedar in the Lake States region.

Section 1. -- VOLUME TABLES

The volume tables for northern white cedar are based upon stem measurements of 227 sample trees widely distributed in the Lake States. The following tabulation shows the numbers of these sample trees by diameter-breast-high (d.b.h.) and total-height classes:

D.b.h. class	Number of trees by total-height class							Total number of trees
	20 feet	30 feet	40 feet	50 feet	60 feet	70 feet	80 feet	
Inches								
1- 5	14	12	2	....	....	....	....	28
6- 9	4	33	41	7	1	....	....	86
10-14	....	12	28	34	16	2	....	92
15-22	....	....	1	4	7	7	2	21
Total	18	57	72	45	24	9	2	227

The first step in volume-table construction was the preparation of a taper table (table 1), showing the most probable values of diameter inside bark at regular intervals of distance above ground, for trees of different d.b.h.'s and total heights. These data on average taper were used to construct most of the following volume tables, and may be used, similarly, to prepare further tables for any product and utilization standard required. For example, it is possible to determine from table 1 how many shingle bolts of different diameters or poles of different lengths may be cut, under any utilization practice, from trees of various sizes (on the assumption that the trees are straight and sound); and tree sections, of the diameters shown in the taper table, may be scaled in any unit of volume. Again, table 1 may be used to determine taper in diameter or circumference as a basis for computing the strength of poles.

Application of the taper data may in some cases be accomplished most conveniently by use of figure 1, which presents in the form of curves the same information which appears in table 1. In figure 1, diameters inside bark at various heights above ground are given, not in inches, but in percent of the diameter outside bark at breast height. The single graph is thus applicable to trees of any d.b.h. The convenience of figure 1 is apparent in cases where interpolation is necessary.

Table 5 is a percentage cubic-foot volume table, showing the volume of tree sections between ground and any given height, in percent of total

tree volume. The table may be used to determine the cubic content of any portion of a tree. Thus, the cubic-foot volume of that section of a 50-foot tree which lies between 5 and 25 feet above ground may be found by subtracting the volume of the first 5 feet of stem (between ground and 10 percent of total height) from the volume of the first 25 feet of stem (between ground and 50 percent of total height).

Other percentage volume tables are presented as tables 6, 7, and 11. These tables provide a basis for estimating the net volume of trees which require either long-butting or the rejection of unmerchantable tops. Tables 6 and 7 contain percentage cubic-foot deductions for butt sections and top sections, respectively, while table 11 contains percentage board-foot deductions for butt sections.

Tables 2, 3, and 4 are cubic-foot volume tables of standard type; tables 8, 9, and 10 are standard board foot volume tables. The board-foot tables are of two kinds. Table 8 is a fixed-top table, showing volume between stump and a top of diameter 6 inches inside bark. This table makes no allowance for the fact that defect may prevent the utilization of trees to the specified point. Tables 9 and 10, on the other hand, are variable-top tables. Their use requires actual estimation or measurement of merchantable height of trees to that point on the stem at which merchantability is limited by branches, defect, or a diameter less than the specified minimum. Table 10, showing board-foot content to a 9-inch minimum top, is designed primarily for use in estimating the volume of tie-cuts.

Tables 12, 13, 14, and 15 indicate for the two products, posts and tie-cuts, the numbers of pieces obtainable from trees of different sizes and the volumes of individual pieces of different diameters.

With the partial exception of tables 9 and 10, the volume tables make no allowance for the presence of rot, sweep, crook, or excessive limbiness. The tables, therefore, in most cases require the supplementary use of cull factors applicable to the particular stand of timber being estimated.

In all cases where volume above stump is presented, the height of the stump has been assumed to be equal to the diameter of the tree, outside bark, at breast height. Thus, stump height is variable, depending upon d.b.h. A variable stump height of this type is believed to approximate both the actual and the desirable woods utilization more closely than would a fixed height of 1 or 2 feet.

Table 1. -- Taper Table for Northern White Cedar in the Lake States

Diameter breast high outside bark (inches)	Total height of trees	Stem diameter inside bark at height above ground of --												
		1 foot	2 feet	3 feet	4.5 feet	8 feet	10 feet	15 feet	20 feet	30 feet	40 feet	50 feet	60 feet	70 feet
	Feet	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
1.....	10	1.2	1.1	1.0	0.9	0.6	.....	.....	.....	.....	.....	.....	.....	.....
	20	1.2	1.1	1.0	0.9	0.8	0.7	0.5	.....	.....	.....	.....	.....	.....
2.....	20	2.3	2.1	2.0	1.9	1.6	1.4	1.0	.....	.....	.....	.....	.....	.....
	30	2.3	2.2	2.0	1.9	1.7	1.6	1.3	1.0	.....	.....	.....	.....	.....
3.....	20	3.5	3.2	3.0	2.8	2.4	2.2	1.5	.....	.....	.....	.....	.....	.....
	30	3.5	3.3	3.1	2.9	2.5	2.4	2.0	1.5	.....	.....	.....	.....	.....
4.....	20	4.6	4.3	4.1	3.8	3.2	2.9	2.0	.....	.....	.....	.....	.....	.....
	30	4.6	4.3	4.1	3.8	3.3	3.1	2.6	2.0	.....	.....	.....	.....	.....
	40	4.6	4.3	4.1	3.8	3.4	3.3	2.9	2.5	1.5	.....	.....	.....	.....
5.....	20	5.7	5.4	5.1	4.7	3.9	3.6	2.4	.....	.....	.....	.....	.....	.....
	30	5.7	5.4	5.1	4.7	4.2	3.9	3.3	2.5	.....	.....	.....	.....	.....
	40	5.7	5.4	5.1	4.7	4.3	4.1	3.6	3.1	1.9	.....	.....	.....	.....
6.....	20	6.9	6.5	6.1	5.7	4.7	4.4	2.9	.....	.....	.....	.....	.....	.....
	30	6.9	6.5	6.1	5.7	5.0	4.7	3.9	3.0	.....	.....	.....	.....	.....
	40	6.9	6.5	6.1	5.7	5.1	4.9	4.3	3.7	2.2	.....	.....	.....	.....
	50	6.9	6.5	6.1	5.7	5.2	5.0	4.5	4.0	3.1	1.9	.....	.....	.....
7.....	20	8.0	7.5	7.1	6.6	5.5	5.1	3.4	.....	.....	.....	.....	.....	.....
	30	8.0	7.5	7.1	6.6	5.8	5.5	4.6	3.5	.....	.....	.....	.....	.....
	40	8.0	7.6	7.1	6.6	5.9	5.7	5.0	4.3	2.6	.....	.....	.....	.....
	50	8.0	7.6	7.2	6.6	6.0	5.8	5.3	4.7	3.6	2.2	.....	.....	.....
8.....	20	9.2	8.6	8.1	7.6	6.3	5.8	3.9	.....	.....	.....	.....	.....	.....
	30	9.2	8.6	8.1	7.6	6.7	6.3	5.3	4.0	.....	.....	.....	.....	.....
	40	9.2	8.6	8.2	7.6	6.8	6.5	5.7	4.9	3.0	.....	.....	.....	.....
	50	9.2	8.6	8.2	7.6	6.9	6.6	6.0	5.4	4.0	2.5	.....	.....	.....
	60	9.2	8.6	8.2	7.6	6.9	6.7	6.1	5.6	4.5	3.3	1.9	.....	.....

9.....	30	10.3	9.7	9.2	8.5	7.5	7.1	5.9	4.4	.....	.....	.....	.....	.....
	40	10.3	9.7	9.2	8.5	7.7	7.3	6.5	5.6	3.4	.....	.....	.....	.....
	50	10.3	9.7	9.2	8.5	7.7	7.4	6.8	6.1	4.5	2.8	.....	.....	.....
	60	10.3	9.7	9.2	8.5	7.8	7.5	6.9	6.3	5.1	3.7	2.1	.....	.....
10.....	30	11.5	10.8	10.2	9.5	8.4	7.8	6.5	5.0	.....	.....	.....	.....	.....
	40	11.5	10.8	10.2	9.5	8.5	8.1	7.2	6.2	3.7	.....	.....	.....	.....
	50	11.5	10.8	10.2	9.5	8.6	8.3	7.5	6.8	5.1	3.1	.....	.....	.....
	60	11.5	10.8	10.2	9.5	8.7	8.4	7.7	7.0	5.7	4.1	2.4	.....	.....
11.....	30	12.6	11.9	11.2	10.4	9.2	8.7	7.2	5.5	.....	.....	.....	.....	.....
	40	12.6	11.9	11.2	10.4	9.4	9.0	7.9	6.8	4.1	.....	.....	.....	.....
	50	12.6	11.9	11.2	10.4	9.5	9.1	8.3	7.4	5.6	3.4	.....	.....	.....
	60	12.6	11.9	11.2	10.4	9.5	9.2	8.5	7.8	6.2	4.5	2.6	.....	.....
12.....	30	13.8	12.9	12.2	11.3	10.0	9.4	7.9	6.0	.....	.....	.....	.....	.....
	40	13.8	12.9	12.2	11.3	10.2	9.8	8.6	7.4	4.5	.....	.....	.....	.....
	50	13.8	13.0	12.3	11.4	10.3	9.9	9.0	8.1	6.1	3.7	.....	.....	.....
	60	13.8	13.0	12.3	11.4	10.4	10.0	9.2	8.5	6.8	4.9	2.9	.....	.....
13.....	40	14.9	14.0	13.2	12.3	11.1	10.6	9.4	8.1	4.9	.....	.....	.....	.....
	50	14.9	14.0	13.2	12.3	11.2	10.8	9.8	8.8	6.6	4.0	.....	.....	.....
	60	14.9	14.1	13.3	12.3	11.3	10.9	10.0	9.2	7.4	5.4	3.1	.....	.....
	70	14.9	14.1	13.3	12.3	11.3	10.9	10.1	9.3	7.8	6.1	4.3	2.3	.....
14.....	40	16.1	15.1	14.3	13.2	11.9	11.4	10.1	8.7	5.3	.....	.....	.....	.....
	50	16.1	15.1	14.3	13.2	12.0	11.6	10.5	9.5	7.1	4.3	.....	.....	.....
	60	16.1	15.1	14.3	13.2	12.1	11.7	10.7	9.9	7.9	5.8	3.4	.....	.....
	70	16.1	15.1	14.3	13.2	12.2	11.8	10.8	10.1	8.4	6.6	4.6	2.4	.....
15.....	40	17.3	16.2	15.3	14.1	12.7	12.2	10.8	9.3	5.6	.....	.....	.....	.....
	50	17.3	16.2	15.3	14.1	12.9	12.4	11.3	10.2	7.6	4.6	.....	.....	.....
	60	17.3	16.2	15.3	14.1	13.0	12.5	11.5	10.6	8.5	6.2	3.6	.....	.....
	70	17.3	16.2	15.3	14.2	13.0	12.6	11.6	10.8	9.0	7.1	5.0	2.6	.....
	80	17.3	16.2	15.3	14.2	13.0	12.6	11.6	10.9	9.2	7.4	5.5	3.7	1.8
16.....	40	18.4	17.3	16.3	15.1	13.6	13.0	11.5	9.9	6.0	.....	.....	.....	.....
	50	18.4	17.3	16.3	15.1	13.8	13.3	12.0	10.8	8.1	4.9	.....	.....	.....
	60	18.4	17.3	16.3	15.1	13.8	13.4	12.3	11.3	9.0	6.6	3.8	.....	.....
	70	18.4	17.3	16.3	15.1	13.9	13.4	12.4	11.5	9.6	7.5	5.3	2.8	.....
	80	18.4	17.3	16.3	15.1	13.9	13.4	12.4	11.6	9.8	7.9	5.9	4.0	2.0

(Continued on page 6.)

Table 1. -- Taper Table for Northern White Cedar in the Lake States -- Continued

Diameter breast high outside bark (inches)	Total height of trees	Stem diameter inside bark at height above ground of --												
		1 foot	2 feet	3 feet	4.5 feet	8 feet	10 feet	15 feet	20 feet	30 feet	40 feet	50 feet	60 feet	70 feet
	Feet	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
17.....	40	19.5	18.3	17.2	16.0	14.4	13.9	12.2	10.5	6.4	.....	.....	.....	.....
	50	19.5	18.3	17.2	16.0	14.6	14.1	12.8	11.5	8.6	5.3	.....	.....	.....
	60	19.5	18.3	17.2	16.0	14.7	14.2	13.1	12.0	9.6	7.0	4.1	.....	.....
	70	19.5	18.4	17.3	16.1	14.8	14.2	13.2	12.2	10.2	8.0	5.6	3.0	.....
	80	19.5	18.4	17.3	16.1	14.8	14.3	13.2	12.3	10.4	8.4	6.3	4.2	2.1
18.....	40	20.7	19.4	18.3	17.0	15.3	14.7	12.9	11.2	6.7	.....	.....	.....	.....
	50	20.7	19.4	18.3	17.0	15.5	14.9	13.5	12.2	9.1	5.6	.....	.....	.....
	60	20.7	19.4	18.3	17.0	15.6	15.0	13.8	12.7	10.2	7.5	4.3	.....	.....
	70	20.7	19.4	18.3	17.0	15.6	15.1	13.9	12.9	10.8	8.5	6.0	3.2	.....
	80	20.7	19.4	18.3	17.0	15.6	15.1	14.0	13.0	11.0	8.9	6.7	4.5	2.2
19.....	40	21.9	20.5	19.4	18.0	16.1	15.5	13.7	11.8	7.1	.....	.....	.....	.....
	50	21.9	20.5	19.4	18.0	16.3	15.7	14.3	12.8	9.6	5.9	.....	.....	.....
	60	21.9	20.5	19.4	18.0	16.4	15.8	14.6	13.4	10.8	7.9	4.6	.....	.....
	70	21.9	20.5	19.4	18.0	16.4	15.8	14.7	13.7	11.4	8.9	6.3	3.4	.....
	80	21.9	20.5	19.4	18.0	16.5	15.9	14.7	13.8	11.6	9.4	7.0	4.7	2.3
20.....	50	23.0	21.6	20.4	18.9	17.2	16.6	15.0	13.5	10.1	6.2	.....	.....	.....
	60	23.0	21.6	20.4	18.9	17.3	16.7	15.4	14.1	11.3	8.3	4.8	.....	.....
	70	23.0	21.6	20.4	18.9	17.3	16.7	15.5	14.4	12.0	9.4	6.6	3.5	.....
	80	23.0	21.6	20.4	18.9	17.4	16.7	15.5	14.5	12.3	9.9	7.4	4.9	2.5
21.....	50	24.2	22.7	21.4	19.8	18.0	17.4	15.8	14.2	10.6	6.5	.....	.....	.....
	60	24.2	22.7	21.4	19.8	18.1	17.5	16.1	14.8	11.9	8.7	5.0	.....	.....
	70	24.2	22.7	21.4	19.8	18.1	17.6	16.3	15.1	12.6	9.9	7.0	3.7	.....
	80	24.2	22.7	21.4	19.9	18.2	17.6	16.3	15.2	12.9	10.4	7.8	5.2	2.6
22.....	50	25.3	23.8	22.5	20.8	18.9	18.2	16.5	14.9	11.1	6.8	.....	.....	.....
	60	25.3	23.8	22.5	20.8	19.0	18.4	16.9	15.5	12.5	9.1	5.3	.....	.....
	70	25.3	23.8	22.5	20.8	19.0	18.4	17.1	15.8	13.2	10.4	7.3	3.9	.....
	80	25.3	23.8	22.5	20.8	19.1	18.4	17.1	15.9	13.5	10.8	8.1	5.4	2.7

Prepared in 1939. Basis, 227 trees.

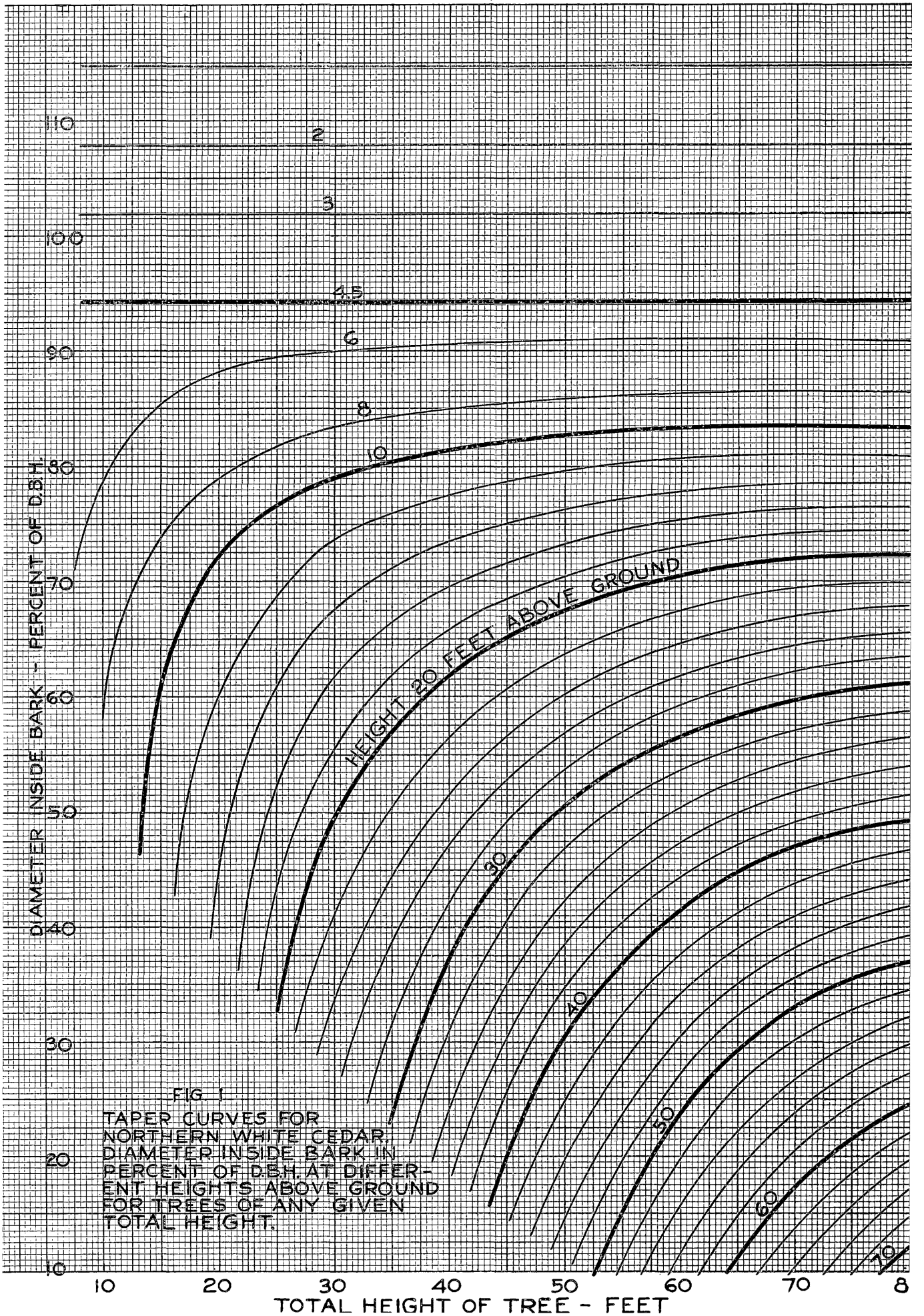

FIG 1
TAPER CURVES FOR NORTHERN WHITE CEDAR. DIAMETER INSIDE BARK IN PERCENT OF D.B.H. AT DIFFERENT HEIGHTS ABOVE GROUND FOR TREES OF ANY GIVEN TOTAL HEIGHT.

Table 2. -- Total Cubic-Foot Volume Table for Northern White Cedar in the Lake States

Diameter breast high (inches)	Volume by total height of trees							
	10 feet	20 feet	30 feet	40 feet	50 feet	60 feet	70 feet	80 feet
	Cubic feet	Cubic feet	Cubic feet	Cubic feet	Cubic feet	Cubic feet	Cubic feet	Cubic feet
1	0.04	0.06	.....	.....	.....	.....	.....	.....
2	0.16	0.25	0.32	.....	.....	.....	.....	.....
3	.....	0.56	0.72	0.87	.....	.....	.....	.....
4	.....	1.00	1.28	1.54	1.78	.....	.....	.....
5	.....	1.56	2.00	2.40	2.78	.....	.....	.....
6	.....	2.25	2.89	3.47	4.01	4.50	.....	.....
7	.....	3.06	3.93	4.72	5.46	6.14	.....	.....
8	.....	4.00	5.14	6.17	7.14	8.02	8.67	.....
9	.....	.....	6.51	7.81	9.04	10.2	11.0	.....
10	.....	.....	8.03	9.64	11.2	12.5	13.5	14.1
11	.....	.....	9.72	11.7	13.5	15.2	16.4	17.1
12	.....	.....	11.6	13.9	16.0	18.0	19.5	20.4
13	.....	.....	13.6	16.3	18.8	21.2	22.9	23.9
14	.....	.....	.....	18.9	21.9	24.6	26.6	27.7
15	.....	.....	.....	21.7	25.1	28.2	30.5	31.8
16	.....	.....	.....	24.7	28.6	32.1	34.7	36.2
17	.....	.....	.....	27.9	32.2	36.2	39.2	40.8
18	.....	.....	.....	31.2	36.1	40.6	43.9	45.8
19	.....	.....	.....	.....	40.3	45.2	48.9	51.0
20	.....	.....	.....	.....	44.6	50.1	54.2	56.5
21	.....	.....	.....	.....	49.2	55.3	59.8	62.3
22	.....	.....	.....	.....	54.0	60.7	65.6	68.4

Volume is that of stem, inside bark, between ground and tip. Prepared from taper table (table 1), 1939. Standard error of single volume estimate, 5.4 percent.

Table 3. -- Merchantable Cubic-Foot Volume Table (2-Inch Top) for Northern White Cedar in the Lake States

Diameter breast high (inches)	Volume by total height of trees						
	20 feet	30 feet	40 feet	50 feet	60 feet	70 feet	80 feet
	Cubic feet	Cubic feet	Cubic feet	Cubic feet	Cubic feet	Cubic feet	Cubic feet
3	0.46	0.56	.....	.....	.....	.....	.....
4	0.92	1.16	1.40	.....	.....	.....	.....
5	1.48	1.87	2.23	2.62	.....	.....	.....
6	2.12	2.72	3.28	3.80	4.26	.....	.....
7	2.86	3.71	4.47	5.20	5.84	.....	.....
8	3.71	4.83	5.84	6.80	7.61	8.20	.....
9	.....	6.10	7.39	8.58	9.63	10.2	.....
10	.....	7.47	9.06	10.5	11.8	12.8	13.3
11	.....	8.98	10.9	12.7	14.3	15.4	16.0
12	.....	10.6	12.9	15.0	16.9	18.4	19.1
13	.....	.....	15.1	17.6	19.8	21.4	22.2
14	.....	.....	17.4	20.3	22.9	24.7	25.8
15	.....	.....	19.9	23.2	26.1	28.3	29.4
16	.....	.....	22.5	26.2	29.6	32.1	33.4
17	.....	.....	25.2	29.6	33.2	36.1	37.4
18	.....	.....	28.2	33.0	37.2	40.2	41.9
19	.....	.....	.....	36.6	41.2	44.6	46.5
20	.....	.....	.....	40.3	45.5	49.2	51.3
21	.....	.....	.....	44.2	49.9	54.0	56.3
22	.....	.....	.....	48.3	54.6	59.0	61.6

Volume is that of stem, inside bark, between stump (height equal to d.b.h.) and fixed top of 2 inches inside bark. Prepared from taper table (table 1), 1939.

Table 4. -- Merchantable Cubic-Foot Volume Table (4-Inch Top) for Northern White Cedar in the Lake States

Diameter breast high (inches)	Volume by total height of trees						
	20 feet	30 feet	40 feet	50 feet	60 feet	70 feet	80 feet
	Cubic feet	Cubic feet	Cubic feet	Cubic feet	Cubic feet	Cubic feet	Cubic feet
5	1.00	1.16	1.31	1.47	.....	.....	.....
6	1.78	2.17	2.49	2.83	3.23	.....	.....
7	2.65	3.30	3.86	4.42	5.02	.....	.....
8	3.58	4.52	5.38	6.24	7.05	.....	.....
9	.....	5.92	7.05	8.18	9.08	.....	.....
10	.....	7.35	8.75	10.2	11.3	12.2	12.5
11	.....	8.82	10.7	12.4	13.8	14.7	15.3
12	.....	10.5	12.7	14.7	16.5	17.6	18.4
13	.....	.....	14.9	17.2	19.5	20.9	21.8
14	.....	.....	17.2	20.1	22.6	24.4	25.3
15	.....	.....	19.7	23.1	25.9	28.0	29.0
16	.....	.....	22.4	26.3	29.5	31.9	32.9
17	.....	.....	.....	29.6	33.2	35.9	37.1
18	.....	.....	.....	32.9	37.1	40.2	41.4
19	.....	.....	.....	.....	41.1	44.2	46.1
20	.....	.....	.....	.....	45.3	48.6	51.1
21	.....	.....	.....	.....	.....	53.4	56.2
22	.....	.....	.....	.....	.....	58.8	61.3

Volume is that of stem, inside bark, between stump (height equal to d.b.h.) and fixed top of 4 inches inside bark. Prepared from taper table (table 1), 1939.

Table 5. -- Percentage Cubic-Foot Volume Table (Percentage of Total Tree Volume between Ground and Given Percentage of Total Height) for Northern White Cedar in the Lake States

Percentage of total tree height above ground	Volume (in percent of total volume) by total height of trees						
	20 feet	30 feet	40 feet	50 feet	60 feet	70 feet	80 feet
2	3.2	4.4	5.0	5.6	6.3	7.2	8.3
4	7.6	9.3	10.1	11.0	12.0	13.2	14.7
6	12.4	14.7	15.5	16.1	17.2	18.7	20.4
8	17.5	19.8	20.4	21.1	22.1	23.6	25.9
10	22.1	24.3	25.1	25.8	26.9	28.5	31.0
15	32.2	34.1	35.4	36.3	37.5	39.2	41.7
20	40.8	42.9	44.3	45.3	46.6	48.3	51.0
30	56.2	57.8	59.0	60.3	61.7	63.5	66.4
40	67.9	69.8	70.9	72.3	74.0	75.9	78.2
50	78.2	80.0	81.3	82.4	83.7	85.3	87.1
55	82.4	84.9	86.1	87.0	87.9	89.1	90.7
60	86.3	89.0	89.9	90.5	91.2	92.1	93.5
65	90.0	92.1	92.8	93.3	93.8	94.2	96.1
70	93.3	94.5	95.1	95.5	95.9	96.7	97.7
75	95.5	96.4	96.7	97.0	97.4	97.9	98.6
80	97.2	97.7	97.9	98.1	98.3	98.6	99.1
85	98.3	98.5	98.7	98.8	98.9	99.1	99.4
90	99.1	99.2	99.3	99.3	99.4	99.5	99.6
95	99.6	99.7	99.7	99.7	99.7	99.7	99.8

Values are given in percent of total volume of stem, inside bark, between ground and tip (as found in table 2). Prepared from taper table (table 1), 1939.

Table 6. -- Percentage Cubic-Foot Volume Table (Volume of Butt Sections of Given Length, in Percent of Total Tree Volume) for Northern White Cedar in the Lake States

Length of butt section above ground (feet)	Volume (in percent of total volume) by total height of trees						
	20 feet	30 feet	40 feet	50 feet	60 feet	70 feet	80 feet
1.....	10.0	7.5	6.2	5.6	5.4	5.4	5.3
2.....	22.1	16.3	12.6	11.0	10.3	10.1	10.0
3.....	32.2	24.4	19.1	16.1	14.6	14.2	13.9
4.....	40.8	31.3	25.1	21.1	18.8	18.0	17.5
6.....	56.2	42.9	35.4	30.0	26.9	25.2	24.4
8.....	67.9	53.1	44.3	38.2	34.2	31.7	31.0
10.....	78.2	62.0	52.2	45.3	40.7	37.8	36.7

Values are given in percent of total volume of stem, inside bark, between ground and tip (as found in table 2). Prepared from taper table (table 1), 1939.

Table 7. -- Percentage Cubic-Foot Volume Table (Volume of Top Sections of Given Length, in Percent of Total Tree Volume) for Northern White Cedar in the Lake States

Length of top section below tip (feet)	Volume (in percent of total volume) by total height of trees						
	20 feet	30 feet	40 feet	50 feet	60 feet	70 feet	80 feet
2	0.9	0.5	0.3	0.2	0.2	0.2	0.1
4	2.8	1.2	0.7	0.5	0.4	0.3	0.2
6	6.7	2.3	1.3	0.9	0.6	0.4	0.3
8	13.7	4.2	2.1	1.4	0.9	0.6	0.4
10	21.8	7.1	3.3	1.9	1.3	0.8	0.5
12	32.1	11.0	4.9	2.8	1.7	1.1	0.6
14	43.8	16.6	7.2	3.9	2.3	1.4	0.7
16	59.2	23.0	10.1	5.3	3.0	1.8	0.9
18	77.9	30.2	13.9	7.2	4.1	2.2	1.1
20	100.0	38.0	18.7	9.5	5.3	2.9	1.4
24	.....	57.1	29.1	15.6	8.8	4.9	2.3
28	.....	.....	41.0	23.5	13.5	7.9	3.9
32	.....	.....	55.7	32.5	17.3	11.5	6.5
36	.....	.....	74.9	42.8	26.0	16.0	9.3
40	.....	.....	100.0	54.7	34.3	21.2	12.9

Values are given in percent of total volume of stem, inside bark, between ground and tip (as found in table 2). Prepared from taper table (table 1), 1939.

Table 8. -- Board-Foot Scribner Volume Table (Fixed Top) for Northern White Cedar in the Lake States

Diameter breast high (inches)	Volume by total height of trees						
	20 feet	30 feet	40 feet	50 feet	60 feet	70 feet	80 feet
	Board feet	Board feet	Board feet	Board feet	Board feet	Board feet	Board feet
8	6	8	10	12	14	.....	.....
9	11	14	17	20	24	.....	.....
10	.....	21	26	31	37	40	42
11	.....	28	36	44	51	57	60
12	.....	37	47	58	68	75	79
13	.....	46	59	73	86	94	99
14	.....	.....	73	90	104	115	122
15	.....	.....	86	108	124	137	146
16	.....	.....	101	126	145	161	171
17	.....	.....	117	146	169	188	198
18	.....	.....	133	167	194	216	227
19	.....	.....	.....	188	220	244	258
20	.....	.....	.....	211	246	272	290
21	.....	.....	.....	236	276	305	323
22	.....	.....	.....	264	305	339	359

Volume is that between stump (height equal to d.b.h.) and fixed top of 6 inches inside bark. Trees scaled in 8-foot log lengths with 0.15-foot trimming allowance. Prepared from taper table (table 1), 1939. Standard error of single volume estimate, 14.2 percent.

Table 9. -- Board-Foot Scribner Volume Table (Variable Top, 6-Inch Minimum) for Northern White Cedar in the Lake States

Diameter breast high (inches)	Volume by total number of 8-foot logs						
	1	2	3	4	5	6	7
	Board feet	Board feet	Board feet	Board feet	Board feet	Board feet	Board feet
8	9	16	.....	.....	.....	.....	.....
9	12	20	30	41	.....	.....	.....
10	16	26	37	50	.....	.....	.....
11	20	32	46	60	.....	.....	.....
12	25	39	56	72	85	95	.....
13	30	47	67	85	99	112	.....
14	.....	56	78	98	115	130	.....
15	.....	67	90	112	132	151	.....
16	.....	78	102	127	150	172	.....
17	.....	90	117	144	171	196	.....
18	.....	.....	131	163	195	221	242
19	.....	.....	.....	183	220	248	272
20	.....	.....	.....	205	245	277	302
21	.....	.....	.....	225	272	308	336
22	.....	.....	.....	250	303	342	371

Volume is that between stump (height equal to d.b.h.) and top of last merchantable log. Minimum top diameter, 6 inches inside bark. Logs scaled with 0.15-foot trimming allowance. Prepared from taper table (table 1), 1939

Table 10. -- Board-Foot Scribner Volume Table (Variable Top, 9-Inch Minimum) for Northern White Cedar in the Lake States

Diameter breast high (inches)	Volume by total number of 8-foot logs				
	1	2	3	4	5
	Board feet	Board feet	Board feet	Board feet	Board feet
11	24	.....	.....	.....	.....
12	28	50	.....	.....	.....
13	34	59	80	.....	.....
14	40	69	94	.....	.....
15	46	80	109	.....	.....
16	53	91	125	152	.....
17	60	104	141	173	.....
18	67	117	159	194	220
19	.....	130	177	216	246
20	.....	.....	195	239	274
21	.....	.....	214	262	302
22	.....	.....	233	286	330

Volume is that between stump (height equal to d.b.h.) and top of last merchantable log. Minimum top diameter, 9 inches inside bark. Logs scaled with 0.15-foot trimming allowance. Prepared from taper table (table 1), 1939.

Table 11. -- Percentage Board-Foot Volume Table (Volume of Butt Sections of Given Length, in Percent of Tree Volume) for Northern White Cedar in the Lake States

Length of butt section above stump (feet)	Volume (in percent of total board-foot volume) by total number of 8-foot logs						
	1	2	3	4	5	6	7
1	12	7	5	4	4	3	3
2	24	15	11	9	7	6	6
3	37	23	16	13	11	10	9
4	49	30	22	17	15	13	12
5	61	38	27	22	19	16	15
6	73	46	33	26	23	20	18
7	86	53	39	31	26	23	21
8	98	61	44	35	30	26	24

Values are given in percent of total board-foot volume between stump (height equal to d.b.h.) and variable top of minimum diameter either 6 or 9 inches (as found in table 9 or 10). Prepared from taper table (table 1), 1939.

Table 12. — Piece-Product Table (Posts) for Northern White Cedar in the Lake States

Tree diameter breast high (inches)	Diameter of post-cuts (in 2-inch classes) inside bark at small end	Number of 7-foot post cuts per 100 trees, by total height of trees						
		20 feet	30 feet	40 feet	50 feet	60 feet	70 feet	80 feet
4.....	4	96	103	125	149	....	....	....
5.....	4	102	185	229	299	....	....	....
6.....	4	76	132	215	282	322	....	....
	6	29	73	83	89	95	....	....
	All classes	105	205	298	371	417	....	....
7.....	4	4	107	167	217	267	....	....
	6	101	108	174	205	214	....	....
	All classes	105	215	341	422	481	....	....
8.....	4	....	38	157	177	217	....	....
	6	103	160	177	255	280	....	....
	8	2	22	32	33	34	....	....
	All classes	105	220	366	465	531	....	....
9.....	4	....	21	105	159	189	....	....
	6	....	103	167	198	232	....	....
	8	....	99	109	133	145	....	....
	All classes	....	223	381	490	566	....	....
10.....	4	....	17	79	124	162	165	185
	6	....	90	130	169	204	230	231
	8	....	115	168	204	216	249	272
	10	....	3	10	9	10	12	13
	All classes	....	225	387	506	592	656	701
11.....	4	....	6	65	102	141	147	171
	6	....	49	113	133	171	191	201
	8	....	89	119	178	198	232	243
	10	....	83	90	97	104	113	116
	All classes	....	227	387	510	614	683	731

(Continued on page 20.)

Table 12. -- Piece-Product Table (Posts) for Northern White Cedar in the Lake States -- Continued

Tree diameter breast high (inches)	Diameter of post-cuts (in 2-inch classes) inside bark at small end	Number of 7-foot post-cuts per 100 trees, by total height of trees						
		20 feet	30 feet	40 feet	50 feet	60 feet	70 feet	80 feet
12	4	....	....	37	75	124	135	167
	6	....	35	100	119	156	163	173
	8	....	94	119	160	168	206	208
	10	....	100	130	155	177	200	209
	12	....	....	1	1	1	2	3
	All classes	....	229	387	510	626	706	760
13	4	....	....	9	49	111	133	162
	6	....	....	87	114	138	140	155
	8	....	....	107	130	154	180	176
	10	....	....	127	158	168	196	214
	12	....	....	57	59	62	78	80
	All classes	....	....	387	510	633	727	787
14	4	....	....	....	29	87	125	159
	6	....	....	82	108	125	127	136
	8	....	....	97	112	123	156	166
	10	....	....	102	140	167	188	194
	12	....	....	106	121	132	146	153
	14	....	....	....	....	1	1	2
	All classes	....	....	387	510	635	743	810
15	4	....	....	....	16	69	119	155
	6	....	....	67	96	103	116	127
	8	....	....	83	93	134	138	153
	10	....	....	91	130	147	164	161
	12	....	....	114	141	147	179	194
	14	....	....	32	34	36	38	40
	All classes	....	....	387	510	636	754	830

(Continued on page 21.)

Table 12. -- Piece-Product Table (Posts) for Northern White Cedar in the Lake States -- Continued

Tree diameter breast high (inches)	Diameter of post-cuts (in 2-inch classes) inside bark at small end	Number of 7-foot post-cuts per 100 trees, by total height of trees						
		20 feet	30 feet	40 feet	50 feet	60 feet	70 feet	80 feet
16	4	-	-	-	8	58	111	150
	6	-	-	52	80	100	108	123
	8	-	-	67	92	119	121	131
	10	-	-	86	110	125	149	146
	12	-	-	93	120	132	161	179
	14	-	-	89	100	102	111	115
	16	-	-	-	-	-	-	1
	All classes	-	-	387	510	636	761	845
17	4	-	-	-	3	40	90	145
	6	-	-	60	70	94	103	116
	8	-	-	62	87	111	110	118
	10	-	-	76	96	110	131	135
	12	-	-	87	112	129	157	165
	14	-	-	100	136	136	154	160
	16	-	-	5	6	16	18	19
	All classes	-	-	390	510	636	763	858
18	4	-	-	-	-	19	85	137
	6	-	-	37	50	84	94	114
	8	-	-	63	85	104	98	108
	10	-	-	83	79	103	122	129
	12	-	-	70	110	124	138	136
	14	-	-	92	105	118	139	154
	16	-	-	45	81	84	87	89
	All classes	-	-	390	510	636	763	867
19	4	-	-	-	-	9	70	125
	6	-	-	19	35	84	91	110
	8	-	-	72	85	91	90	100
	10	-	-	75	75	101	111	117
	12	-	-	56	101	112	123	125
	14	-	-	74	120	110	139	148
	16	-	-	94	94	120	127	134
	18	-	-	-	-	9	12	13
	All classes	-	-	390	510	636	763	872

(Continued on page 22.)

Table 12. -- Piece-Product Table (Posts) for Northern White Cedar in the Lake States -- Continued

Tree diameter breast high (inches)	Diameter of post-cuts (in 2-inch classes) inside bark at small end	Number of 7-foot post-cuts per 100 trees, by total height of trees						
		20 feet	30 feet	40 feet	50 feet	60 feet	70 feet	80 feet
20	4	....	....	....	....	....	57	106
	6	....	....	....	24	77	89	114
	8	....	....	....	78	85	81	95
	10	....	....	....	74	96	102	109
	12	....	....	....	87	97	114	113
	14	....	....	....	100	111	130	137
	16	....	....	....	136	109	125	134
	18	....	....	....	11	61	65	67
	All classes	....	....	....	510	636	763	875
21	4	....	....	....	....	....	44	92
	6	....	....	....	17	61	85	109
	8	....	....	....	70	73	82	91
	10	....	....	....	69	94	90	95
	12	....	....	....	79	86	107	113
	14	....	....	....	87	106	117	116
	16	....	....	....	123	111	126	141
	18	....	....	....	65	102	108	113
	20	....	....	....	....	3	4	5
	All classes	....	....	....	510	636	763	875
22	4	....	....	....	....	....	32	74
	6	....	....	....	10	50	85	110
	8	....	....	....	63	67	78	90
	10	....	....	....	66	87	79	87
	12	....	....	....	65	86	104	106
	14	....	....	....	88	97	106	100
	16	....	....	....	100	102	120	138
	18	....	....	....	115	111	121	130
	20	....	....	....	3	36	38	40
	All classes	....	....	....	510	636	763	875

Number of post-cuts is that obtainable between stump (height equal to d.b.h.) and merchantable top as determined by limbiness or minimum diameter of 3 inches inside bark. The 4-inch diameter class includes diameters of from 3.0 to 4.9 inches (standard 3-inch and 4-inch posts); etc. Prepared in 1939. Basis, 216 trees.

Table 13. -- Cubic-Foot Content of Round Posts of Northern White Cedar in the Lake States

In Post Stands (4- to 8-Inch Trees Predominant)

Diameter of posts, inside bark, at small end (inches)	Content of posts, by length					
	7 feet	8 feet	9 feet	10 feet	12 feet	14 feet
	Cubic feet	Cubic feet	Cubic feet	Cubic feet	Cubic feet	Cubic feet
3	0.49	0.59	0.74	0.82	1.07	1.44
4	0.81	0.95	1.09	1.26	1.66	2.11
5	1.24	1.39	1.61	1.84	2.35	2.90
6	1.63	1.92	2.22	2.54	3.20	3.90
7	2.18	2.52	2.93	3.31	4.15	5.04
8	2.76	3.26	3.76	4.24	5.24	6.36
9	3.45	4.06	4.68	5.29	6.60	8.00

In Small Pole Stands (6- to 14-Inch Trees Predominant)

3	0.53	0.64	0.78	0.90	1.19	1.52
4	0.83	0.98	1.10	1.33	1.71	2.18
5	1.22	1.42	1.66	1.90	2.40	2.97
6	1.65	1.94	2.20	2.56	3.24	3.95
7	2.19	2.54	2.94	3.33	4.19	5.10
8	2.80	3.29	3.76	4.29	5.31	6.46
9	3.48	4.08	4.88	5.33	6.64	8.04

In Large Pole Stands (16-Inch and Larger Trees Predominant)

3	0.51	0.62	0.74	0.85	1.12	1.43
4	0.82	0.96	1.14	1.32	1.69	2.11
5	1.19	1.40	1.64	1.87	2.38	2.96
6	1.66	1.95	2.23	2.57	3.24	3.99
7	2.20	2.57	2.94	3.33	4.20	5.12
8	2.82	3.29	3.80	4.30	5.35	6.50
9	3.51	4.08	4.70	5.30	6.58	8.14

Table 14. -- Piece-Product Table (Ties) for Northern White Cedar in the Lake States

Tree diameter breast high (inches)	Diameter of tie-cuts (in 2-inch classes) inside bark at small end	Number of 8-foot tie-cuts per 100 trees, by total height of trees					
		30 feet	40 feet	50 feet	60 feet	70 feet	80 feet
10.....	10	.....	1	4	4	4	4
11.....	10	40	62	76	84	87	89
12.....	10	96	109	128	141	153	158
	12	.....	.....	2	2	2	2
	All classes	96	109	130	143	155	160
13.....	10	.....	99	124	138	152	161
	12	.....	46	50	60	61	61
	All classes	.....	145	174	198	213	222
14.....	10	.....	84	108	126	144	149
	12	.....	92	102	112	117	126
	All classes	.....	176	210	238	261	275
15.....	10	.....	.....	98	111	125	140
	12	.....	.....	112	134	148	150
	14	.....	.....	30	30	30	30
	All classes	.....	.....	240	275	303	320
16.....	10	.....	.....	84	97	116	125
	12	.....	.....	98	123	132	138
	14	.....	.....	83	88	90	96
	All classes	.....	.....	265	308	338	359

(Continued on page 25.)

Table 14. -- Piece-Product Table (Ties) for Northern White Cedar in the Lake States -- Continued

Tree diameter breast high (inches)	Diameter of tie-cuts (in 2-inch classes) inside bark at small end	Number of 8-foot tie-cuts per 100 trees, by total height of trees					
		30 feet	40 feet	50 feet	60 feet	70 feet	80 feet
17.....	10	.....	.....	85	95	109	119
	12	.....	.....	93	113	121	128
	14	.....	.....	95	113	126	129
	16	.....	.....	14	14	14	14
	All classes	.....	.....	287	335	370	390
18.....	10	.....	.....	76	95	105	107
	12	.....	.....	85	94	108	122
	14	.....	.....	83	109	115	119
	16	.....	.....	61	62	71	71
	All classes	.....	.....	305	360	399	419
19.....	10	.....	.....	64	92	96	110
	12	.....	.....	71	87	117	112
	14	.....	.....	90	98	101	119
	16	.....	.....	93	101	107	107
	18	.....	.....	4	4	4	4
	All classes	.....	.....	322	382	425	446
20.....	10	.....	.....	55	87	100	99
	12	.....	.....	78	77	100	108
	14	.....	.....	88	93	100	112
	16	.....	.....	78	100	109	111
	18	.....	.....	40	40	40	40
	All classes	.....	.....	339	397	449	470
21.....	10	.....	.....	61	69	95	96
	12	.....	.....	74	86	96	98
	14	.....	.....	68	84	90	102
	16	.....	.....	74	89	101	106
	18	.....	.....	76	86	87	87
	20	.....	.....	1	1	1	1
	All classes	.....	.....	354	415	470	490

(Continued on page 26.)

Table 14. -- Piece-Product Table (Ties) for Northern White Cedar in the Lake States -- Continued

Tree diameter breast high (inches)	Diameter of tie-cuts (in 2-inch classes) inside bark at small end	Number of 8-foot tie cuts per 100 trees, by total height of trees					
		30 feet	40 feet	50 feet	60 feet	70 feet	80 feet
22.....	10	.....	.....	72	72	90	90
	12	.....	.....	60	72	91	91
	14	.....	.....	62	82	86	98
	16	.....	.....	76	90	97	107
	18	.....	.....	86	93	102	103
	20	.....	.....	14	21	21	21
	All classes	.....	.....	370	430	487	510

Number of tie-cuts is that obtainable between stump (height equal to d.b.h.) and a top of minimum diameter 9 inches inside bark. The 10-inch diameter class includes diameters of from 9.0 to 10.9 inches; etc. Prepared in 1939. Basis, 113 trees.

Table 15. -- Cubic-Foot and Board-Foot Content of 8-Foot Tie-Cuts of Northern White Cedar in the Lake States

In Small Tie Stands (10- to 14-Inch Trees Predominating)

Unit of measure	Content of tie cuts, by small-end diameter inside bark											
	9 inches	10 inches	11 inches	12 inches	13 inches	14 inches	15 inches	16 inches	17 inches	18 inches	19 inches	20 inches
Cubic feet..	4.1	5.1	6.2	7.4	8.7	10.1	11.6	13.4	15.3	17.4	19.6	22.0

In Large Tie Stands (16-Inch and Larger Trees Predominating)

Cubic feet..	4.1	5.0	6.1	7.3	8.6	9.9	11.3	13.0	14.8	16.7	18.8	21.0

In All Stands

Board feet..	21	27	35	43	52	61	72	83	94	108	121	136

Section 2. -- YIELD TABLES

The following yield tables are based upon 135 fifth-acre sample plots taken in stands of northern white cedar in the three Lake States. The stands sampled were well stocked and essentially even-aged.

The sample plots obtained were found to represent very largely the medium range of sites -- centering around index 51, the average of the sample. For this reason the values given in the tables for the best and the poorest sites are probably much less reliable than are those for the medium sites, indexes 45 and 55. They are believed to be of sufficient value, however, to be included. Site index 75 has been chosen arbitrarily as the best site for presentation in the tables. Cedar stands on this site are of comparatively rare occurrence in the Lake States region, and the figures are of value chiefly for purposes of comparison and interpolation. The same may be said of the poorest site, index 25. The great body of commercial cedar stands in the Lake States probably falls within the medium range of sites, and therefore any general estimates of the possibilities of cedar as a forest crop in the region should be based upon the yields shown for those sites.

Table 16 gives the percentage distribution of trees by d.b.h. classes in normal stands. This distribution served as the basis for preparing all stand tables used in the construction of the yield tables.

The site classification employed is based upon the average total height of dominant and codominant trees in even-aged stands, as given in table 17. The site-index numbers represent heights in feet at a stand age of 160 years, which is approximately the age of maturity. The ages given are, in all cases, total ages, such as would be obtained from ring counts of trees at the ground line. It was found that the average period required for cedar trees to grow to breast height on medium site is 13 years.

Tables 18 and 19 show the development of normal stands in average diameter and average total height, respectively. The number of trees per acre in normal stands is recorded in table 20.

Table 21, showing basal area per acre of all trees in the stand, serves as a basis for determining the density of stands. The values given in this table represent what was considered to be 100-percent stocking.

Tables 22 to 25, inclusive, present values of normal yield in cubic-foot and board-foot volumes; while tables 26, 27, and 28 present similar values for the common cedar products -- poles, posts, and ties. The yields indicated in these tables are those of stands containing only straight and sound trees of average limbiness, and must therefore be re-

duced by means of an appropriate cull allowance when applied to actual stands.

While the yield tables in their present form apply only to stands of northern white cedar which are both fully stocked and even-aged, they may be adapted for use in understocked stands and also in stands containing mixed age groups.

Current periodic growth of understocked cedar stands on any site may be estimated from the yield tables by use of the formula (adapted from Gehrhardt):

$$g = \frac{v}{V} G (2.1 - 1.1 d),$$

where g = current 10-year growth per acre of an understocked stand, v = present per-acre volume of that stand, V = per-acre volume of the normal stand as read from the yield table at the appropriate age, G = current 10-year growth of the normal stand as determined from the yield table, and d = density of the understocked stand (ratio of the total basal area of that stand to the normal basal area, expressed in decimals). This formula was employed in constructing tables 29 to 32, inclusive, which show the periodic annual growth of stands of various densities, expressed in percent of present stand volume.

Uneven-aged stands of northern white cedar will often be found to contain even-aged groups of trees, with one group (the main stand) predominant. The main stand usually accounts for most of the total basal area, and the ages of main-stand trees are set off, sometimes by considerable gaps, from those of the younger and the older trees in the stand. The growth and yield of uneven-aged stands of this type may be estimated from the tables, using as an index of age the average age of the main stand, and as an index of density the basal area of the entire stand.

An approximation of the main-stand age of uneven-aged stands may be obtained by determining the average age of trees belonging to certain key diameter classes, chosen according to the size class of the stand in question. These key diameter classes are as follows:

Size class of stand	Key diameter classes
	Inches
Small post stands (2- and 4-inch trees predominant)	2, 4
Post stands (4- to 8-inch trees predominant)	6, 8
Small pole stands (10- to 14-inch trees predominant)	10, 12, 14
Large pole stands (16-inch and larger trees predominant)	14, 16, 18, 20

The 2-inch diameter class includes diameters of from 1.0 to 2.9 inches; etc.

Table 16. -- Normal-Stand Table for Northern White Cedar in the Lake States

D.b.h. class (inches)	Number of trees (in percent of total number) by average diameter of stand												
	3 inches	4 inches	5 inches	6 inches	7 inches	8 inches	9 inches	10 inches	11 inches	12 inches	13 inches	14 inches	15 inches
2.....	64.9	40.8	25.7	15.5	9.2	5.1	2.0	....	....	....	....	....	....
4.....	31.3	39.1	34.0	26.3	18.4	12.0	7.5	4.7	2.7	1.3	0.3	....	....
6.....	3.7	17.0	28.3	31.6	29.2	23.7	18.1	12.9	8.2	5.0	3.1	1.7	1.0
8.....	0.1	2.8	10.4	19.9	27.0	29.6	27.9	23.6	17.8	12.7	8.6	5.7	3.6
10.....	....	0.2	1.4	6.0	12.7	20.6	26.1	28.0	26.4	22.5	17.8	13.1	9.2
12.....	....	....	0.2	0.6	3.2	7.5	13.8	20.1	24.6	26.2	24.8	21.6	17.0
14.....	....	....	....	0.1	0.3	1.4	4.0	8.4	14.1	19.7	23.4	24.3	23.3
16.....	....	....	....	....	....	0.1	0.6	2.0	5.0	9.2	14.5	19.1	22.1
18.....	....	....	....	....	....	....	....	0.3	1.1	2.8	5.7	10.2	14.7
20.....	....	....	....	....	....	....	....	....	0.1	0.6	1.6	3.5	6.7
22.....	....	....	....	....	....	....	....	....	....	....	0.2	0.7	2.0
24.....	....	....	....	....	....	....	....	....	....	....	....	0.1	0.4

The 2-inch d.b.h. class includes diameters of from 1.0 to 2.9 inches; etc.

Table 17. -- Site-Index Table for Even-Aged Stands of Northern White Cedar in the Lake States

Age of stand (years)	Average total height of dominant trees, by site index --					
	25	35	45	55	65	75
	Feet	Feet	Feet	Feet	Feet	Feet
20	5	7	10	12	14	16
30	7	12	16	20	23	27
40	12	16	21	26	30	35
50	14	19	25	31	36	41
60	16	22	28	35	41	47
70	17	24	31	38	45	52
80	19	26	34	41	49	56
90	20	28	36	44	52	60
100	21	29	38	46	55	64
110	22	31	39	48	58	67
120	23	32	41	50	60	69
130	23	33	42	52	62	71
140	24	34	43	53	63	72
150	24	34	44	54	64	74
160	25	35	45	55	65	75

Table 18. -- Average Diameter of Trees 0.1 Inch and Larger, D.B.H., in Normal Stands of Northern White Cedar in the Lake States

Age of stand (years)	Average breast-height diameter, by site index --					
	25	35	45	55	65	75
	Inches	Inches	Inches	Inches	Inches	Inches
20	.....	.....	0.5	0.7	0.8	1.0
30	0.8	1.1	1.3	1.6	1.9	2.3
40	1.4	1.8	2.2	2.6	3.1	3.6
50	1.9	2.4	3.0	3.6	4.2	5.0
60	2.4	3.0	3.8	4.5	5.3	6.2
70	2.9	3.6	4.5	5.4	6.4	7.5
80	3.3	4.2	5.2	6.2	7.4	8.7
90	3.7	4.8	5.9	7.0	8.3	9.7
100	4.1	5.2	6.4	7.7	9.2	10.7
110	4.4	5.6	7.0	8.4	9.9	11.6
120	4.6	6.0	7.4	8.9	10.5	12.4
130	4.9	6.3	7.8	9.4	11.1	13.0
140	5.1	6.5	8.1	9.8	11.6	13.6
150	5.2	6.7	8.4	10.1	12.0	14.1
160	5.3	6.9	8.6	10.4	12.3	14.5

Table 19. -- Average Total Height of Trees 0.1 Inch and Larger, D.B.H., in Even-Aged Stands of Northern White Cedar in the Lake States

Age of stand (years)	Average total height, by site index --					
	25	35	45	55	65	75
	Feet	Feet	Feet	Feet	Feet	Feet
20	.....	.....	7	8	9	11
30	6	8	11	13	16	19
40	8	11	15	19	24	28
50	10	14	19	24	30	35
60	11	17	23	29	36	42
70	13	19	26	33	41	48
80	15	22	29	37	46	54
90	16	24	32	41	49	58
100	17	26	35	44	53	61
110	19	28	37	46	55	64
120	20	29	38	48	58	67
130	20	30	40	50	60	69
140	21	31	41	51	61	71
150	22	32	42	52	62	72
160	22	32	43	53	63	73

Table 20. -- Number of Trees per Acre 0.1 Inch and Larger, D.B.H., in Normal Stands of Northern White Cedar in the Lake States

Age of stand (years)	Trees per acre, by site index --					
	25	35	45	55	65	75
	Number	Number	Number	Number	Number	Number
20	.....	.....	32,200	24,500	19,300	15,500
30	19,600	14,300	10,500	8,200	6,350	4,950
40	10,000	7,320	5,340	4,070	3,060	2,340
50	6,530	4,550	3,210	2,350	1,730	1,300
60	4,660	3,120	2,150	1,550	1,140	854
70	3,470	2,260	1,560	1,110	818	612
80	2,670	1,740	1,190	855	631	471
90	2,180	1,400	962	691	509	380
100	1,840	1,180	814	578	429	322
110	1,610	1,030	705	506	372	278
120	1,470	929	634	452	332	249
130	1,330	846	575	410	301	225
140	1,250	788	533	380	279	209
150	1,190	747	505	358	262	196
160	1,150	717	481	342	250	185

Table 21. -- Basal Area per Acre of Trees 0.1 Inch and Larger, D.B.H., in Normal Stands of Northern White Cedar in the Lake States

Age of stand (years)	Basal area per acre, by site index --					
	25	35	45	55	65	75
	Square feet	Square feet	Square feet	Square feet	Square feet	Square feet
20	19	32	46	59	72	85
30	72	89	103	119	130	142
40	106	124	137	149	156	164
50	128	145	156	164	169	174
60	144	157	165	171	177	181
70	154	165	171	177	183	188
80	161	169	176	182	188	193
90	165	173	180	186	192	198
100	168	176	183	190	196	202
110	171	179	186	192	199	205
120	173	180	188	194	201	207
130	174	182	189	196	203	209
140	175	183	190	198	205	211
150	176	184	191	199	206	212
160	176	184	192	200	207	213

Table 22. — Total Cubic-Foot Volume per Acre of Trees 0.1 Inch and Larger, D.B.H., in Normal Stands of Northern White Cedar in the Lake States

Age of stand (years)	Volume per acre, by site index —					
	25	35	45	55	65	75
	Cubic feet	Cubic feet	Cubic feet	Cubic feet	Cubic feet	Cubic feet
20	60	130	230	360	525	715
30	330	530	770	1,030	1,335	1,645
40	680	985	1,330	1,680	2,070	2,440
50	985	1,375	1,795	2,195	2,630	3,025
60	1,235	1,690	2,170	2,605	3,080	3,490
70	1,445	1,960	2,490	2,950	3,455	3,875
80	1,620	2,180	2,745	3,240	3,765	4,200
90	1,760	2,360	2,960	3,480	4,030	4,480
100	1,870	2,500	3,135	3,670	4,245	4,705
110	1,965	2,620	3,275	3,830	4,420	4,890
120	2,040	2,720	3,390	3,960	4,565	5,040
130	2,100	2,800	3,485	4,065	4,680	5,165
140	2,150	2,865	3,565	4,155	4,775	5,270
150	2,190	2,915	3,625	4,225	4,855	5,355
160	2,225	2,960	3,680	4,285	4,920	5,425

Volume is that of stem, inside bark, between ground and tip (see table 2).

Table 23. --- Merchantable Cubic-Foot Volume per Acre of Trees 5.0 Inches and Larger, D.B.H., in Normal Stands of Northern White Cedar in the Lake States

Age of stand (years)	Volume per acre, by site index --					
	25	35	45	55	65	75
	Cubic feet	Cubic feet	Cubic feet	Cubic feet	Cubic feet	Cubic feet
20	.....	.....	.....	.....	.....	.....
30	.....	.....	.....	.....	5	30
40	.....	.....	.....	100	340	695
50	.....	10	255	725	1,250	1,685
60	25	275	850	1,435	2,010	2,465
70	185	725	1,390	2,015	2,605	3,070
80	455	1,115	1,835	2,475	3,070	3,535
90	715	1,435	2,185	2,830	3,430	3,900
100	928	1,695	2,430	3,105	3,705	4,175
110	1,100	1,895	2,660	3,315	3,915	4,390
120	1,235	2,050	2,825	3,480	4,080	4,560
130	1,345	2,175	2,955	3,610	4,215	4,695
140	1,425	2,275	3,055	3,715	4,325	4,805
150	1,490	2,350	3,135	3,800	4,405	4,890
160	1,535	2,410	3,195	3,860	4,470	4,950

Volume is that of stem, inside bark, between stump (height equal to d.b.h.) and fixed top of 4 inches inside bark (see table 4).

Table 24. -- Board-Foot Scribner Volume per Acre of Trees 7.0 Inches and Larger, D.B.H., in Normal Stands of Northern White Cedar in the Lake States

Age of stand (years)	Volume per acre, by site index --					
	25	35	45	55	65	75
	Board feet	Board feet	Board feet	Board feet	Board feet	Board feet
20	.....	.....	.....	.....	.....	.....
30	.....	.....	.....	.....	.....	10
40	.....	.....	.....	.....	120	360
50	.....	.....	40	280	900	1,900
60	.....	30	380	1,140	2,650	4,700
70	10	270	1,100	2,560	4,990	7,900
80	100	690	2,160	4,310	7,470	11,070
90	270	1,280	3,360	6,120	9,880	13,970
100	510	1,990	4,580	7,860	12,060	16,490
110	780	2,690	5,730	9,450	13,970	18,580
120	1,040	3,320	6,730	10,830	15,600	20,310
130	1,270	3,850	7,580	11,980	16,960	21,750
140	1,470	4,290	8,260	12,900	18,050	22,900
150	1,640	4,650	8,780	13,600	18,880	23,750
160	1,780	4,920	9,170	14,100	19,480	24,370

Volume is that between stump (height equal to d.b.h.) and fixed top of 6 inches inside bark (see table 8).

Table 25. -- Board-Foot Scribner Volume per Acre of Trees 9.0 Inches and Larger, D.B.H., in Normal Stands of Northern White Cedar in the Lake States

Age of stand (years)	Volume per acre, by site index --					
	25	35	45	55	65	75
	Board feet	Board feet	Board feet	Board feet	Board feet	Board feet
20	.....	.....	.....	.....	.....	.....
30	.....	.....	.....	.....	.....	.....
40	.....	.....	.....	.....	.....	120
50	.....	.....	.....	15	150	845
60	.....	.....	40	230	905	2,840
70	.....	20	265	1,015	2,755	5,960
80	.....	125	795	2,460	5,400	9,540
90	20	360	1,635	4,230	8,205	12,780
100	65	735	2,665	6,005	10,750	15,595
110	145	1,195	3,755	7,690	12,900	17,935
120	270	1,685	4,810	9,225	14,705	19,905
130	405	2,155	5,770	10,520	16,175	21,500
140	540	2,590	6,580	11,570	17,310	22,790
150	645	2,950	7,170	12,380	18,175	23,700
160	725	3,215	7,600	13,000	18,900	24,410

Volume is that between stump (height equal to d.b.h.) and fixed top of 6 inches inside bark (see table 8).

Table 26. -- Number of Poles and Additional 7-Foot Post-Cuts per Acre in Trees 4.0 Inches and Larger, D.B.H., in Normal Stands of Northern White Cedar in the Lake States

Site Index 25

Age of stand (years)	Number of poles per acre, by length										Number of post-cuts per acre
	All	16 feet	20 feet	25 feet	30 feet	35 feet	40 feet	45 feet	50 feet	55 feet	
60	....	....	....	....	....	....	....	....	....	....	100
70	....	....	....	....	....	....	....	....	....	....	450
80	....	....	....	....	....	....	....	....	....	....	700
90	....	....	....	....	....	....	....	....	....	....	870
100	....	....	....	....	....	....	....	....	....	....	855
110	92	92	....	....	....	....	....	....	....	....	614
120	123	107	16	....	....	....	....	....	....	....	546
130	141	122	19	....	....	....	....	....	....	....	517
140	157	135	22	....	....	....	....	....	....	....	479
150	171	144	27	....	....	....	....	....	....	....	447
160	183	151	32	....	....	....	....	....	....	....	421

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50	....	....	....	....	....	....	....	....	....	....	100
60	3	3	....	....	....	....	....	....	....	....	651
70	38	38	....	....	....	....	....	....	....	....	831
80	76	76	....	....	....	....	....	....	....	....	887
90	128	100	27	1	....	....	....	....	....	....	835
100	180	70	81	29	....	....	....	....	....	....	736
110	215	25	144	46	....	....	....	....	....	....	684
120	243	5	178	60	....	....	....	....	....	....	631
130	263	....	188	74	1	....	....	....	....	....	570
140	277	....	189	86	2	....	....	....	....	....	524
150	286	....	190	94	2	....	....	....	....	....	499
160	279	....	190	87	2	....	....	....	....	....	532

(Continued on page 40.)

Table 26. -- Number of Poles and Additional 7-Foot Post-Cuts per Acre in Trees 4.0 Inches and Larger, D.B.H., in Normal Stands of Northern White Cedar in the Lake States -- Continued

Site Index 45

Age of stand (years)	Number of poles per acre, by length										Number of post-cuts per acre
	All	16 feet	20 feet	25 feet	30 feet	35 feet	40 feet	45 feet	50 feet	55 feet	
40	....	....	....	....	....	....	....	....	....	....	40
50	3	....	3	....	....	....	....	....	....	....	721
60	41	....	39	2	....	....	....	....	....	....	1,005
70	103	....	94	9	....	....	....	....	....	....	1,067
80	171	....	145	26	....	....	....	....	....	....	1,006
90	236	....	180	55	1	....	....	....	....	....	895
100	272	....	189	70	13	....	....	....	....	....	798
110	298	....	188	88	22	....	....	....	....	....	709
120	311	....	179	100	32	....	....	....	....	....	643
130	323	....	168	111	43	1	....	....	....	....	567
140	324	....	157	113	53	1	....	....	....	....	527
150	435	109	148	115	61	2	....	....	....	....	154
160	422	99	140	115	66	2	....	....	....	....	163

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40	....	....	....	....	....	....	....	....	....	....	320
50	27	....	27	....	....	....	....	....	....	....	1,044
60	102	....	94	8	....	....	....	....	....	....	1,206
70	192	....	158	32	2	....	....	....	....	....	1,113
80	529	270	169	80	10	....	....	....	....	....	153
90	500	200	150	126	24	....	....	....	....	....	231
100	467	145	115	164	36	7	....	....	....	....	284
110	434	110	60	203	49	12	....	....	....	....	283
120	406	85	10	234	59	16	2	....	....	....	252
130	379	66	....	221	66	22	4	....	....	....	254
140	359	53	....	199	72	28	7	....	....	....	248
150	342	44	....	183	74	32	9	....	....	....	232
160	328	38	....	167	76	35	12	....	....	....	201

(Continued on page 41.)

Table 26. -- Number of Poles and Additional 7-Foot Post Cuts per Acre in Trees 4.0 Inches and Larger, D.B.H., in Normal Stands of Northern White Cedar in the Lake States -- Continued

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Age of stand (years)	Number of poles per acre, by length										Number of post-cuts per acre
	All	16 feet	20 feet	25 feet	30 feet	35 feet	40 feet	45 feet	50 feet	55 feet	
40	6	....	6	....	....	....	....	....	....	....	852
50	420	346	60	14	....	....	....	....	....	....	301
60	528	344	90	91	3	....	....	....	....	....	244
70	525	258	50	206	10	1	....	....	....	....	262
80	484	171	15	234	60	4	....	....	....	....	271
90	437	112	5	178	130	11	1	....	....	....	291
100	392	74	....	125	170	19	3	1	....	....	303
110	352	49	....	90	177	29	6	1	....	....	320
120	320	34	....	68	167	38	11	2	....	....	326
130	293	24	....	52	153	44	16	4	....	....	331
140	274	17	....	41	139	49	21	7	....	....	320
150	259	13	....	33	128	52	24	9	....	....	322
160	248	11	....	28	118	53	27	11	....	....	321

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40	299	269	....	30	....	....	....	....	....	....	398
50	508	363	44	100	1	....	....	....	....	....	284
60	529	268	38	151	71	1	....	....	....	....	278
70	478	157	33	148	134	5	1	....	....	....	282
80	415	80	28	122	169	14	2	....	....	....	336
90	358	32	22	95	175	27	6	1	....	....	370
100	311	11	19	63	163	40	13	2	....	....	381
110	273	2	15	41	94	60	34	27	....	....	332
120	247	....	10	28	52	65	53	39	....	....	312
130	224	....	7	19	40	54	53	50	1	....	312
140	209	....	5	14	31	48	51	54	6	....	292
150	196	....	3	11	25	42	48	58	9	....	276
160	185	....	2	8	20	36	45	62	11	1	267

Stands are assumed to be cut primarily for poles of the longest lengths obtainable. Numbers of posts are those occurring in trees of less than pole size and in tops of pole trees. Products are assumed to be taken to limit of merchantability, as determined by limbiness or minimum diameters, inside bark, as follows -- for poles, according to length: 16 and 25 feet, 4 inches; 30 feet, 5 inches; 35 to 45 feet, 6 inches; 50 and 55 feet, 7 inches; 60 feet, 8 inches -- for posts, 3 inches. Stump height equal to d.b.h.

Table 27. -- Number of 7-Foot Post-Cuts per Acre in Trees 4.0 Inches and Larger, D.B.H., in Normal Stands of Northern White Cedar in the Lake States

Site Index 25

Age of stand (years)	Number of post-cuts per acre, by small-end-diameter class								
	All	4 inches	6 inches	8 inches	10 inches	12 inches	14 inches	16 inches	18 inches
60.....	100	100	.....	.....	.....	.....	.....	.....	.....
70.....	450	450	.....	.....	.....	.....	.....	.....	.....
80.....	700	610	90	.....	.....	.....	.....	.....	.....
90.....	810	635	175	.....	.....	.....	.....	.....	.....
100.....	855	625	220	10	.....	.....	.....	.....	.....
110.....	890	610	260	20	.....	.....	.....	.....	.....
120.....	915	590	295	30	.....	.....	.....	.....	.....
130.....	940	570	330	40	.....	.....	.....	.....	.....
140.....	950	545	355	50	.....	.....	.....	.....	.....
150.....	960	520	380	55	5	.....	.....	.....	.....
160.....	970	500	405	60	5	.....	.....	.....	.....

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50.....	100	100	.....	.....	.....	.....	.....	.....	.....
60.....	660	595	65	.....	.....	.....	.....	.....	.....
70.....	945	730	215	.....	.....	.....	.....	.....	.....
80.....	1,115	765	330	20	.....	.....	.....	.....	.....
90.....	1,220	750	425	45	.....	.....	.....	.....	.....
100.....	1,305	720	500	80	5	.....	.....	.....	.....
110.....	1,375	700	555	110	10	.....	.....	.....	.....
120.....	1,420	680	585	140	15	.....	.....	.....	.....
130.....	1,435	660	595	160	20	.....	.....	.....	.....
140.....	1,445	640	600	180	25	.....	.....	.....	.....
150.....	1,455	625	600	200	30	.....	.....	.....	.....
160.....	1,460	605	605	215	35	.....	.....	.....	.....

(Continued on page 43.)

Table 27. -- Number of 7-Foot Post Cuts per Acre in Trees 4.0 Inches and Larger, D.B.H., in Normal Stands of Northern White Cedar in the Lake States -- Continued

Site Index 45

Age of stand (years)	Number of post-cuts per acre, by small-end-diameter class								
	All	4 inches	6 inches	8 inches	10 inches	12 inches	14 inches	16 inches	18 inches
40	40	40							
50	730	645	85						
60	1,130	830	285	15					
70	1,385	905	440	40					
80	1,545	910	545	85	5				
90	1,660	880	620	145	15				
100	1,710	830	645	205	30				
110	1,735	785	650	250	45	5			
120	1,740	740	640	290	65	5			
130	1,735	695	625	320	85	10			
140	1,720	655	615	340	100	10			
150	1,700	625	600	355	110	10			
160	1,680	600	590	360	115	15			

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40	320	260	60						
50	1,125	870	250	5					
60	1,520	1,030	440	50					
70	1,725	1,045	570	105	5				
80	1,840	975	660	170	35				
90	1,905	880	705	250	65	5			
100	1,935	795	710	325	95	10			
110	1,910	710	680	380	120	20			
120	1,860	635	650	405	140	30			
130	1,800	570	620	410	160	40			
140	1,745	520	585	410	180	45	5		
150	1,680	480	550	405	190	50	5		
160	1,610	450	520	390	195	50	5		

(Continued on page 44.)

Table 27. -- Number of 7-Foot Post-Cuts per Acre in Trees 4.0 Inches and Larger, D.B.H., in Normal Stands of Northern White Cedar in the Lake States -- Continued

Site Index 65

Age of stand (years)	Number of post-cuts per acre, by small-end-diameter class								
	All	4 inches	6 inches	8 inches	10 inches	12 inches	14 inches	16 inches	18 inches
30	40	40							
40	870	720	150						
50	1,575	1,115	430	30					
60	1,925	1,170	640	110	5				
70	2,065	1,090	740	210	25				
80	2,085	915	780	320	65	5			
90	2,065	800	755	380	110	20			
100	1,995	695	700	410	155	30	5		
110	1,900	600	635	410	195	50	10		
120	1,805	520	565	410	225	70	15		
130	1,720	450	505	400	250	90	25		
140	1,650	400	460	385	260	110	30	5	
150	1,600	365	425	370	270	120	40	10	
160	1,560	345	400	360	270	130	45	10	

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30	355	270	85						
40	1,325	1,035	280	10					
50	1,910	1,220	610	75	5				
60	2,160	1,150	780	205	25				
70	2,145	920	820	325	70	10			
80	2,075	760	765	390	135	25			
90	1,965	620	665	420	200	50	10		
100	1,830	510	555	420	245	80	20		
110	1,710	425	470	400	270	110	30	5	
120	1,630	365	410	375	280	140	50	10	
130	1,555	325	360	350	280	160	60	20	
140	1,490	300	320	320	275	170	75	25	5
150	1,430	275	290	300	270	175	80	30	10
160	1,385	260	265	280	260	180	90	40	10

Stands are assumed to be cut exclusively for posts. Number of post-cuts is that obtainable between stump (height equal to d.b.h.) and merchantable top as determined by limbiness or minimum diameter of 3 inches inside bark (see table 12). The 4-inch small-end-diameter class includes diameters (inside bark) of from 3.0 to 4.9 inches (standard 3-inch and 4-inch posts), etc.

Table 28. -- Number of 8-Foot Tie-Cuts per Acre in Trees 11.0 Inches and Larger, D.B.H., in Normal Stands of Northern White Cedar in the Lake States

Age of stand (years)	Number of tie-cuts per acre, by small-end-diameter class						
	All	10 inches	12 inches	14 inches	16 inches	18 inches	20 inches
Site Index 25							
120	1	1	.....	.....	.....	.....	.....
130	2	2	.....	.....	.....	.....	.....
140	2	2	.....	.....	.....	.....	.....
150	3	3	.....	.....	.....	.....	.....
160	3	3	.....	.....	.....	.....	.....
Site Index 35							
90	1	1	.....	.....	.....	.....	.....
100	3	3	.....	.....	.....	.....	.....
110	6	6	.....	.....	.....	.....	.....
120	9	8	1	.....	.....	.....	.....
130	13	12	1	.....	.....	.....	.....
140	18	16	2	.....	.....	.....	.....
150	22	20	2	.....	.....	.....	.....
160	26	24	2	.....	.....	.....	.....
Site Index 45							
70	1	1	.....	.....	.....	.....	.....
80	2	2	.....	.....	.....	.....	.....
90	8	7	1	.....	.....	.....	.....
100	17	15	2	.....	.....	.....	.....
110	28	25	3	.....	.....	.....	.....
120	43	39	4	.....	.....	.....	.....
130	61	53	7	1	.....	.....	.....
140	77	66	10	1	.....	.....	.....
150	91	76	13	2	.....	.....	.....
160	96	81	13	2	.....	.....	.....

(Continued on page 46.)

Table 28. — Number of 8-Foot Tie Cuts per Acre in Trees 11.0 Inches and Larger, D.B.H., in Normal Stands of Northern White Cedar in the Lake States — Continued

Site Index 55

Age of stand (years)	Number of tie cuts per acre, by small-end-diameter class						
	All	10 inches	12 inches	14 inches	16 inches	18 inches	20 inches
70	2	2	.....	.....	.....	.....	.....
80	13	12	1	.....	.....	.....	.....
90	33	29	4	.....	.....	.....	.....
100	63	54	8	1	.....	.....	.....
110	92	78	13	1	.....	.....	.....
120	123	100	21	2	.....	.....	.....
130	154	120	30	4	.....	.....	.....
140	184	137	40	6	1	.....	.....
150	204	148	47	8	1	.....	.....
160	222	156	54	11	1	.....	.....

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60	4	4	.....	.....	.....	.....	.....
70	15	14	1	.....	.....	.....	.....
80	48	44	4	.....	.....	.....	.....
90	96	81	14	1	.....	.....	.....
100	147	115	28	3	1	.....	.....
110	198	146	44	6	2	.....	.....
120	245	170	61	11	3	.....	.....
130	286	186	77	19	4	.....	.....
140	323	199	92	27	5	.....	.....
150	348	205	103	32	7	1	.....
160	363	208	110	36	8	1	.....

(Continued on page 47.)

Table 28. -- Number of 8-Foot Tie-Cuts per Acre in Trees 11.0 Inches and Larger, D.B.H., in Normal Stands of Northern White Cedar in the Lake States -- Continued

Site Index 75

Age of stand (years)	Number of tie-cuts per acre, by small-end-diameter class						
	All	10 inches	12 inches	14 inches	16 inches	18 inches	20 inches
50	1	1	.....	.....	.....	.....	.....
60	14	13	1	.....	.....	.....	.....
70	59	50	8	1	.....	.....	.....
80	121	98	21	2	.....	.....	.....
90	193	144	41	7	1	.....	.....
100	267	183	68	14	2	.....	.....
110	330	205	94	26	5	.....	.....
120	375	214	112	39	9	1	.....
130	408	216	127	50	13	2	.....
140	433	214	138	60	18	3	.....
150	452	210	144	69	24	5	.....
160	463	203	147	76	29	7	1

Stands are assumed to be cut exclusively for ties. Number of tie-cuts is that obtainable between stump (height equal to d.b.h.) and a top of minimum diameter 9 inches inside bark (see table 14). The 10-inch small-end-diameter class includes diameters (inside bark) of from 3.0 to 4.9 inches; etc.

Table 29. -- Periodic Annual Growth, in Percent of Total Cubic-Foot Volume, of Trees 0.1 Inch and Larger, D.B.H., in Stands of Northern White Cedar in the Lake States

Stand-age period (years)	Annual growth, by site index --					
	25	35	45	55	65	75
Density 100 (Normal Stands)						
	Percent	Percent	Percent	Percent	Percent	Percent
20 to 30	46.1	31.4	23.5	18.6	15.5	13.0
30 to 40	10.6	8.60	7.32	6.30	5.50	4.85
40 to 50	4.50	3.98	3.50	3.07	2.70	2.38
50 to 60	2.54	2.30	2.09	1.88	1.70	1.54
60 to 70	1.73	1.59	1.46	1.33	1.22	1.11
70 to 80	1.20	1.12	1.04	0.97	0.90	0.84
80 to 90	0.86	0.82	0.78	0.74	0.70	0.66
90 to 100	0.64	0.61	0.58	0.56	0.53	0.51
100 to 110	0.50	0.48	0.45	0.43	0.41	0.39
110 to 120	0.38	0.37	0.35	0.34	0.33	0.32
120 to 130	0.30	0.29	0.28	0.27	0.26	0.24
130 to 140	0.24	0.23	0.22	0.22	0.21	0.20
140 to 150	0.18	0.18	0.17	0.17	0.16	0.16
150 to 160	0.15	0.15	0.14	0.14	0.13	0.13
Density 75 (Three-Fourths-Normal Stands)						
20 to 30	58.8	40.0	30.0	23.7	19.8	16.6
30 to 40	13.5	11.0	9.33	8.03	7.01	6.18
40 to 50	5.74	5.07	4.46	3.91	3.44	3.03
50 to 60	3.24	2.93	2.66	2.40	2.17	1.96
60 to 70	2.21	2.03	1.86	1.70	1.56	1.42
70 to 80	1.53	1.43	1.33	1.24	1.15	1.07
80 to 90	1.10	1.05	0.99	0.94	0.89	0.84
90 to 100	0.82	0.78	0.74	0.71	0.68	0.64
100 to 110	0.64	0.61	0.58	0.55	0.52	0.50
110 to 120	0.48	0.47	0.45	0.43	0.42	0.40
120 to 130	0.38	0.37	0.36	0.34	0.33	0.31
130 to 140	0.31	0.30	0.29	0.28	0.26	0.26
140 to 150	0.24	0.23	0.22	0.22	0.21	0.20
150 to 160	0.19	0.19	0.18	0.18	0.17	0.17

(Continued on page 49.)

Table 29. -- Periodic Annual Growth, in Percent of Total Cubic-Foot Volume, of Trees 0.1 Inch and Larger, D.B.H., in Stands of Northern White Cedar in the Lake States -- Continued

Density 50 (Half-Normal Stands)

Stand age period (years)	Annual growth, by site index --					
	25	35	45	55	65	75
	Percent	Percent	Percent	Percent	Percent	Percent
20 to 30	71.5	48.7	36.4	28.8	24.0	20.2
30 to 40	16.4	13.3	11.3	9.76	8.52	7.52
40 to 50	6.98	6.17	5.42	4.76	4.18	3.69
50 to 60	3.94	3.56	3.24	2.91	2.64	2.39
60 to 70	2.68	2.46	2.26	2.06	1.89	1.72
70 to 80	1.86	1.74	1.61	1.50	1.40	1.30
80 to 90	1.33	1.27	1.21	1.15	1.08	1.03
90 to 100	0.99	0.94	0.90	0.86	0.82	0.78
100 to 110	0.78	0.74	0.70	0.67	0.64	0.61
110 to 120	0.59	0.57	0.55	0.53	0.51	0.49
120 to 130	0.46	0.45	0.43	0.42	0.40	0.38
130 to 140	0.37	0.36	0.35	0.33	0.32	0.31
140 to 150	0.29	0.28	0.27	0.26	0.25	0.25
150 to 160	0.23	0.23	0.22	0.21	0.21	0.20

Density 25 (Quarter-Normal Stands)

20 to 30	84.1	57.3	42.9	33.9	28.3	23.7
30 to 40	19.3	15.7	13.4	11.5	10.0	8.85
40 to 50	8.21	7.26	6.39	5.60	4.93	4.34
50 to 60	4.64	4.20	3.81	3.43	3.10	2.81
60 to 70	3.16	2.90	2.66	2.43	2.23	2.03
70 to 80	2.19	2.04	1.90	1.77	1.64	1.53
80 to 90	1.57	1.50	1.42	1.35	1.28	1.21
90 to 100	1.17	1.11	1.06	1.02	0.97	0.92
100 to 110	0.91	0.87	0.83	0.79	0.75	0.72
110 to 120	0.69	0.67	0.64	0.62	0.60	0.57
120 to 130	0.55	0.53	0.51	0.49	0.47	0.45
130 to 140	0.44	0.43	0.41	0.39	0.38	0.36
140 to 150	0.34	0.33	0.32	0.31	0.30	0.29
150 to 160	0.28	0.27	0.26	0.25	0.24	0.24

Based on table 22. Basal area per acre of trees 0.1 inch and larger in d.b.h. (see table 21) is assumed to be the index of stand density. Growth is given in percent of volume of stem, inside bark, between ground and tip (see table 2).

Table 30. -- Periodic Annual Growth, in Percent of Merchantable Cubic-Foot Volume, of Trees 5.0 Inches and Larger, D.B.H., in Stands of Northern White Cedar in the Lake States

Density 100 (Normal Stands)

Stand-age period (years)	Annual growth, by site index --					
	25	35	45	55	65	75
	Percent	Percent	Percent	Percent	Percent	Percent
40 to 50	.....	.....	.....	61.0	26.8	14.2
50 to 60	.....	.....	23.3	9.82	6.10	4.62
60 to 70	70.4	16.2	6.34	4.04	2.97	2.44
70 to 80	14.7	5.41	3.18	2.27	1.78	1.53
80 to 90	5.65	2.88	1.90	1.44	1.17	1.02
90 to 100	2.98	1.78	1.23	0.96	0.80	0.71
100 to 110	1.84	1.19	0.85	0.68	0.58	0.51
110 to 120	1.24	0.83	0.61	0.49	0.42	0.38
120 to 130	0.87	0.61	0.46	0.38	0.33	0.30
130 to 140	0.63	0.45	0.35	0.29	0.25	0.23
140 to 150	0.44	0.33	0.26	0.22	0.19	0.17
150 to 160	0.32	0.24	0.19	0.16	0.14	0.13

Density 75 (Three-Fourths-Normal Stands)

40 to 50	.....	.....	.....	77.7	34.2	18.1
50 to 60	.....	.....	29.7	12.5	7.78	5.89
60 to 70	89.8	20.7	8.08	5.15	3.79	3.11
70 to 80	18.7	6.90	4.05	2.89	2.27	1.95
80 to 90	7.20	3.67	2.42	1.84	1.49	1.30
90 to 100	3.80	2.27	1.57	1.22	1.02	0.91
100 to 110	2.35	1.52	1.08	0.87	0.74	0.65
110 to 120	1.58	1.06	0.78	0.62	0.54	0.48
120 to 130	1.11	0.78	0.59	0.48	0.42	0.38
130 to 140	0.80	0.57	0.45	0.37	0.32	0.29
140 to 150	0.56	0.42	0.33	0.28	0.24	0.22
150 to 160	0.41	0.31	0.24	0.20	0.18	0.17

(Continued on page 51.)

Table 30. -- Periodic Annual Growth, in Percent of Merchantable Cubic-Foot Volume, of Trees 5.0 Inches and Larger, D.B.H., in Stands of Northern White Cedar in the Lake States -- Continued

Stand-age period (years)	Annual growth, by site index --					
	25	35	45	55	65	75
	Percent	Percent	Percent	Percent	Percent	Percent
Density 50 (Half-Normal Stands)						
40 to 50	.....	.....	.....	94.5	41.6	22.0
50 to 60	.....	.....	36.1	15.2	9.46	7.16
60 to 70	109.	25.2	9.83	6.26	4.60	3.78
70 to 80	22.8	8.39	4.93	3.52	2.76	2.37
80 to 90	8.76	4.46	2.94	2.23	1.81	1.58
90 to 100	4.62	2.76	1.91	1.49	1.24	1.10
100 to 110	2.85	1.84	1.32	1.05	0.90	0.79
110 to 120	1.92	1.29	0.95	0.76	0.65	0.59
120 to 130	1.35	0.95	0.71	0.59	0.51	0.46
130 to 140	0.98	0.70	0.54	0.45	0.39	0.36
140 to 150	0.68	0.51	0.40	0.34	0.29	0.26
150 to 160	0.50	0.37	0.29	0.25	0.22	0.20
Density 25 (Quarter-Normal Stands)						
40 to 50	.....	.....	.....	111.	48.9	25.9
50 to 60	.....	.....	42.5	17.9	11.1	8.43
60 to 70	128.	29.6	11.6	7.37	5.42	4.45
70 to 80	26.8	9.87	5.80	4.14	3.25	2.79
80 to 90	10.3	5.26	3.47	2.63	2.14	1.86
90 to 100	5.44	3.25	2.24	1.75	1.46	1.30
100 to 110	3.36	2.17	1.55	1.24	1.06	0.93
110 to 120	2.26	1.51	1.11	0.89	0.77	0.69
120 to 130	1.59	1.11	0.84	0.69	0.60	0.55
130 to 140	1.15	0.82	0.64	0.53	0.46	0.42
140 to 150	0.80	0.60	0.47	0.40	0.35	0.31
150 to 160	0.58	0.44	0.35	0.29	0.26	0.24

Based on table 23. Basal area per acre of trees 0.1 inch and larger in d.b.h. (see table 21) is assumed to be the index of stand density. Growth is given in percent of volume of stem, inside bark, between stump (height equal to d.b.h.) and fixed top of 4 inches inside bark (see table 4).

Table 31. -- Periodic Annual Growth, in Percent of Board-Foot Scribner Volume, of Trees 7.0 Inches and Larger, D.B.H., in Stands of Northern White Cedar in the Lake States

Density 100 (Normal Stands)

Stand-age period (years)	Annual growth, by site index --					
	25	35	45	55	65	75
	Percent	Percent	Percent	Percent	Percent	Percent
40 to 50	.....	.....	.....	.....	69.2	42.8
50 to 60	.....	.....	86.3	31.1	19.5	14.8
60 to 70	.....	79.4	19.0	12.5	8.80	6.81
70 to 80	90.0	15.8	9.60	6.80	4.98	4.01
80 to 90	17.0	8.70	5.60	4.21	3.23	2.62
90 to 100	8.99	5.50	3.68	2.84	2.21	1.80
100 to 110	5.25	3.50	2.51	2.01	1.58	1.27
110 to 120	3.33	2.32	1.75	1.46	1.16	0.93
120 to 130	2.23	1.63	1.25	1.06	0.88	0.70
130 to 140	1.60	1.16	0.90	0.77	0.64	0.52
140 to 150	1.16	0.84	0.63	0.55	0.46	0.37
150 to 160	0.85	0.58	0.44	0.37	0.32	0.26

Density 75 (Three-Fourths-Normal Stands)

40 to 50	.....	.....	.....	.....	88.2	54.6
50 to 60	.....	.....	110.	39.7	24.9	18.9
60 to 70	.....	101.	24.2	15.9	11.2	8.68
70 to 80	115.	20.1	12.2	8.67	6.35	5.11
80 to 90	21.7	11.1	7.14	5.37	4.12	3.34
90 to 100	11.5	7.01	4.69	3.62	2.82	2.30
100 to 110	6.69	4.46	3.20	2.56	2.01	1.62
110 to 120	4.25	2.96	2.23	1.86	1.48	1.19
120 to 130	2.84	2.08	1.59	1.35	1.12	0.89
130 to 140	2.04	1.48	1.15	0.98	0.82	0.66
140 to 150	1.48	1.07	0.80	0.70	0.59	0.47
150 to 160	1.08	0.74	0.56	0.47	0.41	0.33

(Continued on page 53.)

Table 31. -- Periodic Annual Growth, in Percent of Board-Foot Scribner Volume, of Trees 7.0 Inches and Larger, D.B.H., in Stands of Northern White Cedar in the Lake States -- Continued

Density 50 (Half-Normal Stands)

Stand-age period (years)	Annual growth, by site index --					
	25	35	45	55	65	75
	Percent	Percent	Percent	Percent	Percent	Percent
40 to 50	.....	.....	.....	.....	107.	66.3
50 to 60	.....	.....	134.	48.2	30.2	22.9
60 to 70	.....	123.	29.4	19.4	13.6	10.6
70 to 80	140.	24.5	14.9	10.5	7.72	6.22
80 to 90	26.4	13.5	8.68	6.53	5.01	4.06
90 to 100	13.9	8.52	5.70	4.40	3.43	2.79
100 to 110	8.14	5.42	3.89	3.12	2.45	1.97
110 to 120	5.16	3.60	2.71	2.26	1.80	1.44
120 to 130	3.46	2.53	1.94	1.64	1.36	1.08
130 to 140	2.48	1.80	1.40	1.19	0.99	0.81
140 to 150	1.80	1.30	0.98	0.85	0.71	0.57
150 to 160	1.32	0.90	0.68	0.57	0.50	0.40

Density 25 (Quarter-Normal Stands)

40 to 50	.....	.....	.....	.....	126.	78.1
50 to 60	.....	.....	157.	56.8	35.6	27.0
60 to 70	.....	145.	34.7	22.8	16.1	12.4
70 to 80	164.	28.8	17.5	12.4	9.09	7.32
80 to 90	31.0	15.9	10.2	7.68	5.89	4.78
90 to 100	16.4	10.0	6.72	5.18	4.03	3.28
100 to 110	9.58	6.39	4.58	3.67	2.88	2.32
110 to 120	6.08	4.23	3.19	2.66	2.12	1.70
120 to 130	4.07	2.97	2.28	1.93	1.61	1.28
130 to 140	2.92	2.12	1.64	1.41	1.17	0.95
140 to 150	2.12	1.53	1.15	1.00	0.84	0.68
150 to 160	1.55	1.06	0.80	0.68	0.58	0.47

Based on table 24. Basal area per acre of trees 0.1 inch and larger in d.b.h. (see table 21) is assumed to be the index of stand density. Growth is given in percent of volume between stump (height equal to d.b.h.) and fixed top of 6 inches inside bark (see table 8).

Table 32. -- Periodic Annual Growth, in Percent of Board-Foot Scribner Volume, of Trees 9.0 Inches and Larger, D.B.H., in Stands of Northern White Cedar in the Lake States

Density 100 (Normal Stands)

Stand-age period (years)	Annual growth, by site index --					
	25	35	45	55	65	75
	Percent	Percent	Percent	Percent	Percent	Percent
40 to 50	.....	.....	.....	.....	.....	60.0
50 to 60	.....	.....	.....	150.	50.1	23.5
60 to 70	.....	.....	60.0	34.5	20.5	11.0
70 to 80	.....	60.0	20.1	14.2	9.60	6.00
80 to 90	.....	19.0	10.2	7.30	5.20	3.50
90 to 100	22.5	10.0	6.30	4.50	3.20	2.30
100 to 110	12.7	6.30	4.10	2.90	2.10	1.60
110 to 120	7.95	4.10	2.80	2.00	1.40	1.10
120 to 130	5.23	2.80	2.00	1.40	1.00	0.80
130 to 140	3.31	2.00	1.40	1.00	0.70	0.60
140 to 150	2.09	1.30	0.90	0.70	0.50	0.40
150 to 160	1.29	0.90	0.60	0.50	0.40	0.30

Density 75 (Three-Fourths-Normal Stands)

40 to 50	.....	.....	.....	.....	.....	76.5
50 to 60	.....	.....	.....	191.	63.9	30.0
60 to 70	.....	.....	76.5	44.0	26.1	14.0
70 to 80	.....	76.5	25.6	18.1	12.2	7.65
80 to 90	.....	24.2	13.0	9.31	6.63	4.46
90 to 100	28.7	12.8	8.03	5.74	4.08	2.93
100 to 110	16.2	8.03	5.23	3.70	2.68	2.04
110 to 120	10.1	5.23	3.57	2.55	1.78	1.40
120 to 130	6.67	3.57	2.55	1.78	1.28	1.02
130 to 140	4.22	2.55	1.78	1.28	0.89	0.76
140 to 150	2.66	1.66	1.15	0.89	0.64	0.51
150 to 160	1.64	1.15	0.76	0.64	0.51	0.38

(Continued on page 55.)

Table 32. -- Periodic Annual Growth, in Percent of Board-Foot Scribner Volume, of Trees 9.0 Inches and Larger, D.B.H., in Stands of Northern White Cedar in the Lake States -- Continued

Stand-age period (years)	Annual growth, by site index --					
	25	35	45	55	65	75
	Density 50 (Half-Normal Stands)					
	Percent	Percent	Percent	Percent	Percent	Percent
40 to 50	.....	.....	.....	.....	.....	93.0
50 to 60	.....	.....	.....	232.	77.7	36.4
60 to 70	.....	.....	93.0	53.5	31.8	17.0
70 to 80	.....	93.0	31.2	22.0	14.9	9.30
80 to 90	.....	29.4	15.8	11.3	8.06	5.42
90 to 100	34.9	15.5	9.76	6.98	4.96	3.56
100 to 110	19.7	9.76	6.36	4.50	3.26	2.48
110 to 120	12.3	6.36	4.34	3.10	2.17	1.70
120 to 130	8.11	4.34	3.10	2.17	1.55	1.24
130 to 140	5.13	3.10	2.17	1.55	1.08	0.93
140 to 150	3.24	2.02	1.40	1.08	0.78	0.62
150 to 160	2.00	1.40	0.93	0.78	0.62	0.46
	Density 25 (Quarter-Normal Stands)					
40 to 50	.....	.....	.....	.....	.....	110.
50 to 60	.....	.....	.....	274.	91.4	42.9
60 to 70	.....	.....	110.	63.0	37.4	20.1
70 to 80	.....	110.	36.7	25.9	17.5	11.0
80 to 90	.....	34.7	18.6	13.3	9.49	6.39
90 to 100	41.1	18.2	11.5	8.21	5.84	4.20
100 to 110	23.2	11.5	7.48	5.29	3.83	2.92
110 to 120	14.5	7.48	5.11	3.65	2.56	2.01
120 to 130	9.54	5.11	3.65	2.56	1.82	1.46
130 to 140	6.04	3.65	2.56	1.82	1.28	1.10
140 to 150	3.81	2.37	1.64	1.28	0.91	0.73
150 to 160	2.35	1.64	1.10	0.91	0.73	0.55

Based on table 25. Basal area per acre of trees 0.1 inch and larger in d.b.h. (see table 21) is assumed to be the index of stand density. Growth is given in percent of volume between stump (height equal to d.b.h.) and fixed top of 6 inches inside bark (see table 8).